Activity title

Aerodynamics

Time required

1 hour

Activity summary

Making and testing an aerofoil

By the end of this activity, you will be able to:

- Understand the terms lift, drag and thrust
- Understand how an aerofoil works
- Make and test a simple aerofoil design

What equipment will you need?

- Small pieces of paper or thin card (A5)
- Tape, e.g. masking tape
- String
- Hair dryer or fan

How to do it

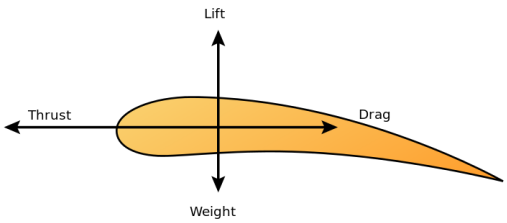
Understanding aerodynamics is key to understanding flight. Aerofoils are designed to allow aircraft to fly. The design of these is crucial to minimise drag and increase lift.

You will make and test a simple design for an aerofoil and will learn about the terms lift, drag and thrust and how these apply to aircraft. You will build on your knowledge of aerodynamics theory and how this can be applied.

An aerofoil is a cross-sectional shape of a wing. It looks like a teardrop with a long-curved edge on top and a short, flatter edge on the bottom. The camber is the difference in symmetry between the two acting surfaces of an aerofoil i.e. the top and lower surfaces. Camber is designed into an aerofoil to maximise its lift.

<u>Lift, drag and thrust</u>

- Lift is the force that opposes the weight of an aircraft, causing it to move upwards.
- Drag is the force that opposes the forward motion of an aircraft through the air.
- Thrust is the pushing force that moves an aircraft forwards through the air.



Aerofoils, or wings, allow aircraft to achieve flight by reducing drag and increasing lift.

Activity title: **Aerodynamics**

Now try this

You are now going to make and test an aerofoil:

1. **Making an aerofoil**

- Fold your A5 piece of paper in half.
- Create an upwards camber by moving the top end of the paper back slightly from the bottom end.
- Stick the top end down with tape.

- Put your aerofoil on your desk and apply moving air to the front of it, level with the edge of the table. Air could be applied by blowing or using an electric fan on a low setting. Make sure the air is blown at the underside of the aerofoil as it may flip over.

2. **Further testing ideas**

The aerofoil could also be attached to the desk with a piece of string during the testing to prevent it from moving backwards and so that flight can be more easily observed.

This could be fed through the space inside the aerofoil, and taped to the desktop at both ends, allowing some slack so that it can raise/fly.

For more information on aerodynamics:

NASA – Beginner's guide to aerodynamics: Resources for teaching and studying the theory of aerodynamics. https://www.grc.nasa.gov/www/k-12/airplane/bga.html

To make your aerofoil lift in a more controlled way, make a hole through the top and bottom of the aerofoil and feed a piece of string through the holes. Now hold the string above and below the aerofoil, and when blown it will raise up on the string.

You could also

Make alternative aerofoil designs

Try making different shapes of aerofoil and test how the change in shape affects how each one works.

For example:

- An aerofoil with a flat bottom and a small upwards camber.
- An aerofoil with a flat bottom and a larger upwards camber.
- An aerofoil with a square front.

Further activities you could carry out

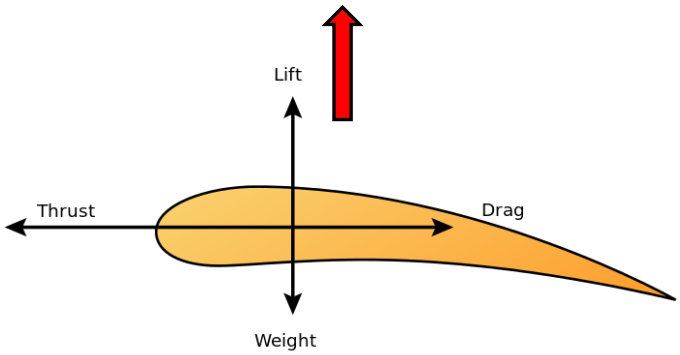
For an example of creating an aerofoil using CAD:

YouTube - Creating an aerofoil in Solidworks: - How to use CAD software to create an aerofoil design.
https://www.youtube.com/watch?v=KyiqxdDlxQA

Activity title: **Aerodynamics**

What results were expected?

As you apply moving air to the front of the aerofoil it should lift upwards at varying speeds dependent of the shape.



Aerofoils with a smaller upwards bow and a flat bottom are designed to reduce drag and increase speed, for example fighter jets and race planes.

Aerofoils with a larger upwards bow and a flat bottom are designed to produce higher lift but slower speeds, for example transport aircraft.

A square shaped front would not be a good design for an aerofoil as it the air would not flow aerodynamically around the shape.